

THE BUTTERFLIES (LEPIDOPTERA) OF MIDDLE, MONDRAIN, SANDY HOOK, WOODY AND GOOSE ISLANDS IN THE RECHERCHE ARCHIPELAGO, WESTERN AUSTRALIA

ANDREW A.E. WILLIAMS¹ and ROBERT J. POWELL²

¹Department of Conservation and Land Management, W.A. Wildlife Research Centre, PO Box 51, Wanneroo, WA 6065

²54 Bournemouth Crescent, Wembley Downs, WA 6019

Abstract

Twelve butterfly species are recorded from Middle, Mondrain, Sandy Hook, Woody and Goose Islands in the Recherche Archipelago, Western Australia: *Hesperilla chrysotricha chrysotricha* (Meyrick & Lower), *Delias aganippe* (Donovan), *Pieris rapae rapae* (Linnaeus), *Geitoneura klugii* (Guérin-Ménéville), *Heteronympha merope duboulayi* (Butler), *Junonia villida calybe* (Godart), *Vanessa kershawi* (McCoy), *Vanessa itea* (Fabricius), *Nacaduba biocellata biocellata* (C. & R. Felder), *Theclinessthes serpentata serpentata* (Herrich-Schäffer), *Neolucia agricola occidentens* Waterhouse & Lyell and *Zizina labradus labradus* (Godart). Their status on the islands is discussed and the butterfly fauna compared with that of other Western Australian islands.

Introduction

The islands of the Recherche Archipelago are located off the southern coastline of Western Australia, from Esperance eastwards. About 200 islands make up the archipelago; some lie close to the coast while others are a considerable distance off shore. The furthest, Salisbury Island, is 50 km southeast of the mainland at Cape Arid. In November of 1998, 1999 and 2003, we surveyed five of the larger islands for butterflies: Middle (34°06'S, 123°11'E); Mondrain (34°08'S, 122°15'E); Sandy Hook (34°02'S, 122°00'E); Woody (33°58'S, 122°01'E); and Goose (34°05'S, 123°11'E). Prior to these visits, no butterflies had been recorded from the archipelago.

The islands are mostly granitic remnants of the Precambrian Shield (Brown *et al.* 1984). Middle Island (1060 ha) is the largest and physiographically most diverse of the islands. It lies about 8.5 km SSE of Cape Arid and 120 km ESE of Esperance. Its topography is dominated by Flinders Peak (174 m), a large granite dome at the western end of the island. The coastline is very irregular, with numerous promontories and coves with white sandy beaches. In some places limestone overlies the granite substrate. Lake Hillier, a pink, hypersaline lake, is located in the northeast of the island. The vegetation on Middle Island is diverse and 20 vegetation associations have been mapped (Hopkins 1981); 235 plant species are now recorded (Keighery 1995). Half the island was burnt in a fire in 1972 and almost all the rest in 1977. The areas burnt now support dense regrowth vegetation.

Mondrain Island (787 ha) is the second largest island in the Recherche. It lies 42 km SE of Esperance and some 11 km from the mainland. It is irregular in shape, 6 km long and 2.8 km wide at its widest point. Permanent or semi-permanent water is found in seepage areas on the western side of the island and in rock pools on Baudin Peak (222 m), the island's highest point. The

island is characterised by a series of granite domes with large expanses of bare rock. The vegetation is varied and some 283 native species are recorded (Pearson *et al.* 2004). In shallow soils between the granite domes is dense scrub, predominantly of *Melaleuca globifera*, *Acacia conniana* and *Allocasuarina huegeliana*. In swales, where the soil is deeper, low forest of *Eucalyptus lehmanni* occurs. Open sandy areas support *Carpobrotus virescens* and meadows of yellow-flowered *Senecio lautus*, especially where nesting shearwaters have enriched the soil. In other areas dense *Rhagodia baccata* and *Atriplex cinerea* occur.

Sandy Hook Island (238 ha) is located 9 km WSW of Cape Le Grand and 22 km WNW of Mondrain Island. Like other islands in the archipelago it is characterised by large granite domes and boulders. Much of the interior is a high plateau overlain with shallow sand and gravel, which supports a dense eucalypt and shrub association (Willis 1953). On the southeastern side of the island is a small sandy cove, above which is a sheltered wooded gully. The gully vegetation is dominated by *Eucalyptus conglobata*, *Acacia* and *Hakea* species. Introduced grasses, thick in places, are well established.

Woody Island (196 ha) is located in Esperance Bay, 7 km from the mainland and 15 km SE of Esperance. It is about 2 km (E-W) by 1.5 km (N-S) and rises at its centre to 130 m. It is composed of granite, which is frequently exposed between areas of shallow overlying soil. The island is well vegetated. The shallow soils support variable heath and mallee formations. Eucalypt forest is found in areas of deeper soil. Abbott and Black (1978) recognised six vegetation classes; the two main ones are low open-heath on the western half of the island and *Eucalyptus*-dominated closed forest on the sheltered slopes south and east of the summit. The island has been grazed in the past and parts of the northeastern portion are still cleared.

Goose Island (56 ha) is the smallest of the islands to be surveyed for butterflies. It lies less than a kilometre to the north of Middle I. and 7.5 km from the mainland. Its highest point is a gently sloping, exposed granite dome. Limestone cliffs are found on the eastern side of the island. The vegetation is generally very low, in response to the shallow soils and probably also to grazing by rabbits, which have been introduced to the island. The presence of rabbits probably also explains, to a large degree, the extent to which this vegetation differs in composition from that of nearby Middle I. Dominant species such as *Rhagodia baccata*, *Senecio lautus* and *Carpobrotus virescens* are uncommon on Middle I. *R. baccata* is found in sandy areas honeycombed with petrel burrows. Shrubs of *Pimelea ferruginea* occur in shallow soils near sheets of exposed granite.

Methods

Butterfly surveys of the Recherche islands were carried out in November of 1998, 1999 and 2003, at the time of year when peak butterfly activity is to be expected on the adjacent mainland. It was not possible to visit all five islands

in a single year. Most time was devoted to the largest islands, Middle and Mondrain, with their more diverse habitats. Four days were spent on Middle Island, in 2003, and a total of five days on Mondrain, in 1998 and 1999. Woody Island was visited for one day and Sandy Hook Island for just a few hours in November 1998. A further day spent on Sandy Hook Island in 1999 by one of us (AW) was generally unproductive, due to cool, cloudy conditions. Goose Island was surveyed for a few hours in November 2003 during the Middle Island expedition. Suitable sunny conditions for butterflies were experienced on each survey trip. One of us (RP) spent a few hours on Woody Island in December 1993, and his opportunistic observations are included in this paper.

Prior to visiting the islands, we identified the major habitat types, with the aid of aerial photographs and published data on the topography and vegetation. Published plant lists were scrutinised for known butterfly food plants. During our surveys, all accessible types of habitat were carefully explored and food plants, when encountered, were examined for signs of larvae. Accessible hilltops were monitored for hilltopping butterflies. Botanical nomenclature follows Green (1985).

Results

The results of our survey are summarised in Table 1. Voucher specimens have been lodged in the Insect Collection of the Department of Conservation and Land Management or (plants) in the Western Australian Herbarium.

HESPERIIDAE

Hesperilla chrysotricha chrysotricha (Meyrick & Lower)

Recorded from Middle I. Locally abundant around the food plant, *Gahnia trifida* (Cyperaceae), growing in a narrow belt along the eastern shoreline of Lake Hillier. In the early mornings, males were observed flying amongst the *Gahnia* foliage, presumably in search of emerging females. Several pupae were found in typical sealed cylindrical shelters on the food plant.

PIERIDAE

Delias aganippe (Donovan)

Recorded from Woody I. This species was not observed during the surveys in 1998, 1999 and 2003. However, several specimens were seen by one of us (RP) on an earlier trip to Woody I. in December 1993.

Pieris rapae rapae (Linnaeus)

Recorded from Mondrain, Sandy Hook and Woody Is. On Woody I., a few individuals were seen on the eastern side of the island, particularly in cleared areas near the landing point. On Sandy Hook I. the species was not seen in 1998. A single individual was observed in November 1999, even though the weather on that visit was cool and overcast. On Mondrain I. *P. r. rapae* was usually uncommon. However, in 1998, after a period of off-shore north-easterly winds, the species suddenly became abundant.

Table 1. Butterflies recorded from Middle, Mondrain, Sandy Hook, Woody and Goose Islands of the Recherche Archipelago.

| Family and species | Middle | Mondrain | Sandy Hook | Woody | Goose |
|---|-----------|----------|------------|----------|-----------|
| HESPERIIDAE | | | | | |
| <i>Hesperilla chrysotricha chrysotricha</i> | • | | | | |
| PIERIDAE | | | | | |
| <i>Delias aganippe</i> | | | | • | |
| <i>Pieris rapae rapae</i> | | • | • | • | |
| NYMPHALIDAE | | | | | |
| <i>Geitoneura klugii</i> | | | • | | |
| <i>Heteronympha merope duboulayi</i> | | | | • | |
| <i>Vanessa kershawi</i> | • | • | | • | • |
| <i>Vanessa itea</i> | • | • | | • | |
| <i>Junonia villida calybe</i> | • | • | | • | |
| LYCAENIDAE | | | | | |
| <i>Nacaduba biocellata biocellata</i> | | | | • | |
| <i>Neolucia agricola occidens</i> | • | • | • | • | |
| <i>Theclinesthes serpentata serpentata</i> | | • | • | • | • |
| <i>Zizina labradus labradus</i> | • | • | | • | |
| Total number of species: | 12 | 6 | 7 | 4 | 10 |
| | | | | | 2 |

NYMPHALIDAE*Geitoneura klugii* (Guérin-Méneville)

Recorded from Sandy Hook I. This species was encountered only on the eastern side of the island, in a sheltered valley above the landing beach. Butterflies were collected around patches of *Austrostipa flavescens* Labill. (Poaceae), a known larval food plant.

Heteronympha merope duboulayi (Butler)

Recorded from Woody I. The common brown was not recorded during the surveys in 1998, 1999 or 2003, which took place in the first half of November and may have preceded the butterfly's appearance. RP, in his brief visit to Woody I. on 28 December 1993, recorded one female. Robyn Benken (pers. comm.) found the species to be abundant during her visit on 12-13 December 2004; all specimens she was able to observe closely were male.

Vanessa kershawi (McCoy)

Recorded from Middle, Mondrain, Woody and Goose Is. On Middle I., numbers of fresh specimens were observed along the sheltered north-facing and eastern coastline. Inland they were also common around Lake Hillier. The butterflies were often seen feeding at flowering shrubs of *Pimelea ferruginea* and *Senecio lautus*. On Mondrain I. the species was encountered in 1998 and 1999. Butterflies were commonest in open meadows of flowering *Senecio lautus* and *Carpobrotus virescens*. This habitat is often

found in nutrient enriched soils honeycombed with the burrows of the fleshy-footed shearwater (*Puffinus carneipes* Gould). On Woody I., *V. kershawi* was common in cleared areas near the landing point on the eastern side of the island. Adults were seen feeding on the flowers of *Senecio lautus* and the introduced *Arctotheca calendula*. *A. calendula* (Asteraceae) is a known food plant and *V. kershawi* was seen ovipositing on this plant. On Goose I. two specimens were observed, feeding on the flowers of *Pimelea ferruginea*.

Vanessa itea (Fabricius)

Recorded from Middle, Mondrain and Woody Is. The yellow admiral was commonest on Mondrain and Woody Is, where its food plant *Parietaria debilis* (Urticaceae) was abundant. On Mondrain I., adults were seen in coastal areas and upland meadows of flowering *Senecio lautus* and *Carpobrotus virescens*. Large numbers of larvae were found on *P. debilis*, which was growing profusely under dense stands of *Melaleuca lanceolata*. Some were collected and subsequently reared in captivity. On Woody I., about six adults were seen in the late morning to early afternoon. Four or more were seen hilltopping after 1630 h at the island's highest point. *P. debilis* was abundant and typical larval shelters were found in three or more places. On both Mondrain and Woody Is, many of the *V. itea* were freshly emerged. On Middle I. only a few plants of *P. debilis* were found, under a small stand of *M. lanceolata* north of Lake Hillier that had escaped the two major fires. On this island *V. itea* was uncommon; only about six individuals were seen over four days. Some of these fed briefly at the flowers of *Pimelea ferruginea*. One of the plants of *P. debilis* had a typical larval shelter.

Junonia villida calybe (Godart)

Recorded from Middle, Mondrain and Woody Is. On Middle I., the species was encountered only on the rocky promontory between Coverdale Cove and Cormorant Cove. At this site three worn males had established territories along the rocky shoreline. On Mondrain I. the species was also scarce. A fresh specimen was captured on an exposed granite sheet in November 1998, and none was seen in 1999. Only on Woody I. was the butterfly common. Several specimens were observed and collected at the eastern end of the island near the landing point. The species was observed with *V. kershawi* on flowering *Senecio lautus* and flying along pathways and in open areas.

LYCAENIDAE

Nacaduba biocelata biocellata (C. & R. Felder)

Recorded from Woody I. This common lycaenid was encountered only on Woody I. A few individuals were seen near the summit of the island, around freshly opened flowers of *Acacia rostellifera*.

Neolucia agricola occidens Waterhouse & Lyell

Recorded from Middle, Mondrain, Sandy Hook and Woody Is. Fringed heath-blues were found on all but Goose I. On Middle I. they were plentiful.

Butterflies were almost always seen close to flowering shrubs of *Pultenaea obcordata* or *Eutaxia obovata*, which were common on the southeastern side of Lake Hillier and along the northern and eastern coastline. By contrast, the species was uncommon on the other islands. One freshly emerged specimen was captured on a low flowering *Acacia rostelifera* near the summit of Woody I. On Sandy Hook I., a specimen was collected flying round a *Hakea* shrub. On Mondrain I., one butterfly was collected in 1998 and another closely observed on a shrub at the northern end of the island in 1999.

Theclinesstes serpentata serpentata (Herrich-Schäffer)

Recorded from Mondrain, Sandy Hook, Woody and Goose Is. Saltbush blues were seen mostly near one of their food plants, *Rhagodia baccata* (Chenopodiaceae); no other species of food plant was encountered. We recorded this butterfly on all the islands except Middle I., where we found very few *Rhagodia* specimens. On Middle I. it was evident that this plant's occurrence had been much reduced by grazing Tamar wallabies (*Macropus eugenii* (Desmarest)). On Mondrain I., the butterflies were abundant in 1998, around *Rhagodia baccata* above the landing beach on the northeastern side of the island. On the return visit, in 1999, the butterflies were absent from this site. On Sandy Hook I. one butterfly was seen (but not collected) in 1998. On Woody I. the species was moderately common in low-lying, partly cleared areas on the sheltered northeastern side. Here, too, the butterflies were found near *R. baccata*. On Goose I., where succulent mats of *R. baccata* grow extensively in nutrient enriched sandy areas honeycombed with shearwater burrows, freshly emerged butterflies were abundant.

Zizina labradus labradus (Godart)

Recorded from Middle, Mondrain and Woody Is. On Middle I. the species was uncommon. Two individuals were found on the northern coastline between Coverdale Cove and North East Point, one feeding on a flowering *Senecio lautus*. On Mondrain I. it was recorded in 1998 and 1999. On our first visit, *Z. l. labradus* was not seen for the first three days and appeared on the island only after a prolonged period of strong off-shore winds. The butterflies were first observed about 0930 h on 12 November 1998; by late morning they had become abundant and were frequently seen on the slopes of the hill at the northern end of the island, in meadows and around vegetation between granite sheets. In 1999 only one butterfly was recorded. On Woody I., *Z. l. labradus* was locally common near the landing point.

Discussion

In considering the behaviour and ecology of butterfly species on islands, of particular interest is their status. They can be present either permanently or temporarily, referred to here as 'permanent' or 'temporary' species.

For a permanent species, the population is likely to be composed entirely or largely of individuals that are resident on the island. There may be a viable,

isolated population, comprising resident individuals with no influx from elsewhere, or such an influx may occur, boosting a resident population. In the latter case, the resident population may to some degree rely on the influx for its viability. If the butterfly population is to remain permanent, however, it cannot rely on that influx too heavily, since there are bound to be years or times when the usual influx does not occur (for example, as a result of a mainland population being destroyed by fire).

Most of the permanent species might be expected to have a single generation a year, since such species need a food plant only at the time the larvae are feeding. Those species that have continuous generations would normally need to have food plants available in a suitable state of growth throughout the year, to allow each new generation to breed; this is unlikely on islands, with their limited number of plant species. An influx of adults from elsewhere cannot be relied on to maintain the presence of a species with continuous generations at times of the year when it is unable to breed.

The temporary species will all be ones able to travel to the island from elsewhere. Some may go there deliberately, either to breed when the season or conditions are right or to rest during a migration. Others may be there by accident, having the intention of remaining on the mainland but being displaced out to sea by off-shore winds.

Four of the species we recorded - *Hesperilla chrysotricha chrysotricha*, *Geitoneura klugii*, *Heteronympha merope duboulayi* and *Neolucia agricola occidens* - are likely to be permanent species on the islands where found.

In Western Australia, *Hesperilla chrysotricha* has one or possibly two generations a year (Braby 2000). Breeding was confirmed on Middle Island. For most of the year the larvae or pupae remain in shelters on the *Gahnia trifida* food plant. This island population is likely to be an isolated one, viable enough to have persisted since the island was formed. The fire in 1972 burnt the eastern part of the island, including the *Gahnia* vegetation fringing the eastern side of Lake Hillier. However, isolated clumps of the food plant may have survived on the northern side of the lake. Moreover, *G. trifida* occurs also on the lower eastern slopes of Flinders Peak (A.J.M. Hopkins, pers. comm.). Either part of the lakeside population may have survived, or recolonization may have occurred from a population at Flinders Peak.

Neolucia agricola has one generation a year (Braby 2000) and is not known to be very mobile. Its populations on the islands are likely to be isolated ones that have persisted. On Middle Island the butterflies were very common and were habitually seen around flowering shrubs of *Pultenaea obcordata* and *Eutaxia obovata*. (Fabaceae). These are likely food plants, as other *Pultenaea* and *Eutaxia* species are known larval food plants. A potential food plant, *Bossiaea dentata*, occurs on the other islands where *N. agricola* was recorded.

Geitoneura klugii has only one generation a year (Braby 2000). It is not known to be a very mobile species; our experience in Perth is that it wanders barely at all from the bushlands where it breeds. The population on Sandy Hook I., 8 km from the mainland, is likely to be an isolated one, where the species almost certainly breeds on the native grass *Austrostipa flavescens*.

Given that *Heteronympha merope* has only one generation a year (Braby 2000) and that the grasses on Woody Island include two of its known food plants, *Cynodon dactylon* and *Poa poiformis*, this butterfly may be a permanent breeding species on this island. This likelihood is further emphasized by the apparent abundance of the species on the island. *H. m. duboulayi* has been found to be quite mobile, even though it is not known to migrate (Braby 2000). A specimen recorded on Garden Island may have travelled 2 km or more from the Perth mainland (Williams 1997) and the Woody Island population may possibly be boosted by occasional arrivals from the mainland. Whether or not *H. m. duboulayi* occurs on other islands in the Recherche would need to be determined by surveys in summer.

Most of the eight remaining species are likely to be temporary. For *Vanessa itea*, *V. kershawi* and *Junonia villida*, this is partly because they have continuous generations and partly because they are highly mobile migrants (Braby 2000). That we have recorded them from most of the islands we have visited, including those of the Houtman Abrolhos, 60-80 km off the coast (Williams and Powell 1998), suggests they are easily capable of travelling the much shorter distances between the mainland and the Recherche islands surveyed. Being swift, powerful fliers, they probably rely less on favourable winds for such journeys than do other, less powerful species.

On the Recherche islands, *V. itea* breeds on *Parietaria debilis* and probably also on *Urtica urens*, which is available on Woody Island (Western Australian Herbarium Collection). Both these plants are annuals, which germinate in May or June and die off in November to December. *V. itea* would be unable to persist on the islands over the four to five months when its food plants are unavailable.

V. kershawi likely breeds from time to time on the islands, where likely food plants include *Arctotheca calendula*, *Gnaphalium* sp. and *Rhodanthe* sp. Likewise, *J. villida* may breed on known food plants such as *Centaurium spicatum* and *Scaevola aemula*. It is unlikely, however, that either species would breed on the Recherche islands over the whole year.

Both *Delias aganippe* and *Pieris rapae* are somewhat mobile (Braby 2000). *D. aganippe* is clearly a temporary species on at least Woody Island, since none of its food plants is present. Although we did not find it on any of the other islands, it is likely to visit other islands in the archipelago from time to time, and could breed on Middle Island where a known food plant, *Amyema melaleuca*, occurs. The sudden increase in numbers of *P. rapae* observed on

Mondrain Island after a period of off-shore winds suggests that this species will travel from the mainland to the islands, at least when the winds are favourable. *Cakile maritima* (Brassicaceae), a possible food plant, grows on many of the islands. On the mainland the species is certainly mobile. It was introduced to Melbourne in 1939, and within three years had reached the west coast (Thomas and Lewington 1991). In Europe, large migratory flights occur from time to time.

Although the number of generations a year of *Zizina labradus labradus* has not been recorded, the presence of the adults throughout the year in temperate Australia (Braby 2000) suggests that it breeds continuously. It is therefore probably a temporary species on the Recherche islands. The sudden abundance of this species on Mondrain Island following its apparent absence, and after a period of off-shore winds, strongly suggests that it travels to the islands from the mainland, at least when the winds are favourable.

From the present information, the status on the islands of the remaining two species, *Nacaduba biocellata* and *Theclinesthes serpentata*, is difficult to determine. It is unknown whether *N. biocellata* has a single generation or a succession of generations (Braby 2000), or whether it is sufficiently mobile to travel between the mainland and the islands. The number of annual generations of *T. serpentata* has not been established (Braby 2000). Its absence from the portion of Mondrain Island surveyed in 1999, following an abundance in 1998, indicates that its occurrence on the island may be only temporary. If the Mondrain population is temporary, the same can be expected for the populations on Woody and Goose Islands.

The butterfly fauna on the adjacent mainland has a direct bearing on what butterflies may be expected to occur on off-shore islands. Some species appear to have remained on the islands since their separation from the mainland, supported there by surviving available food plants. Others are now known to be regular visitors to the islands.

V. kershawi, *V. itea*, *J. villida* and *Z. labradus*, have been recorded on all the island groups surveyed: Bernier and Dorre Is, the Houtman Abrolhos, Rottneest, Garden and the Recherche Archipelago (Williams and Hall 1993, Williams 1997, Williams *et al.* 1998, Williams and Powell 1998, Williams *et al.* 2000). All are temporary species, which either visit the islands under their own power or are carried there by off-shore winds.

The silver-spotted ochre, *Trapezites argenteoornatus* (Hewitson), is well established on all but the Recherche islands. Its success can be attributed to the abundance of its food plant *Acanthocarpus preissii* on the west coast islands. Two lycaenids, *T. serpentata* and *N. agricola*, are successful island species. *T. serpentata* occurs on all but Garden Island, where its saltbush food plant is lacking. *N. agricola* appears to breed and maintain stable populations on the Abrolhos and Recherche islands.

Acknowledgements

We are grateful to regional staff of the Department of Conservation and Land Management in Esperance, particularly Bernie Haberley, who organised our boat transport to and from Mondrain and Sandy Hook Islands, and Geoff Young, who made arrangements for us to travel to Middle Island with Department field staff Ray (Moey) Ramsden, Craig Clements and Wayne Williams. Greg Keighery of the Department of Conservation and Land Management identified plant specimens from Middle Island.

References

- ABBOTT, I. and BLACK, R. 1978. An ecological reconnaissance of four islands in the Archipelago of the Recherche, Western Australia. *Journal of the Royal Society of Western Australia* **60**: 115-128.
- BRABY, M.F. 2000. *Butterflies of Australia: their identification, biology and distribution*. CSIRO Publishing, Collingwood; xx + 976 pp.
- BROWN, J.M., HOPKINS, A.J.M., TRUDGEN, M.E. and WESTON, A.S. 1984. Regeneration after fire in 170 year old vegetation on Middle Island, South Western Australia. Pp 18-19, in: Dell, B. (ed.), *Medicos IV, Proceedings*. Perth.
- GREEN, J.W. 1985. *Census of the vascular plants of Western Australia*. Western Australian Herbarium, Department of Agriculture, Perth; 312 pp.
- HOPKINS, A.J.M. 1981. Studies on Middle Island in the Recherche Archipelago. *Swans* **11**: 6-9.
- KEIGHERY, G. 1995. Additions to the flora of the Recherche Archipelago. *Western Australian Naturalist* **5**: 133-138.
- PEARSON, D., HOPPER, S., COCHRANE, A., COMER, S. and DANKS, A. 2004. Fire in the Arc. *Landscape* **20**: 10-17.
- THOMAS, J. and LEWINGTON, R. 1991. *The butterflies of Britain and Ireland*. Dorling Kindersley Limited, London.
- WILLIAMS, A.A.E. 1997. The butterflies (Lepidoptera) of Garden and Rottnest islands, Western Australia. *Australian Entomologist* **24**(1): 27-34.
- WILLIAMS, A.A.E. and HALL, G.P. 1993. New records of butterflies (Lepidoptera: Heperioida and Papilionoidea) from Bernier Island, Western Australia. *Australian Entomologist* **20**(1): 45-46.
- WILLIAMS, A.A.E. and POWELL, R.J. 1998. The butterflies (Lepidoptera) of East and West Wallabi Islands, Western Australia. *Australian Entomologist* **25**(4): 107-112.
- WILLIAMS, A.A.E., SCANLON, M.D. and HIMBECK, K.J. 1998. New records of butterflies (Lepidoptera) from Dorre Island, Western Australia. *Victorian Entomologist* **28**: 55-58.
- WILLIAMS, A.A.E., WILLIAMS, M.R. and GRAHAM, A.J. 2000. Further notes on some Western Australian butterflies. *Victorian Entomologist* **30**: 3-9.
- WILLIS, J.H. 1953. Land flora. *Report of the Australian Geographical Society Expedition to the Recherche Archipelago*. Part 3a: 3-30.